Observations of repeated refuge use by the Little Whip Snake *Parasuta flagellum* (Elapidae)

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Abstract
Examples of individual Little Whip Snakes *Parasuta flagellum* being located beneath the same day-time refuge after periods of five months or more (spanning all or part of the species' active season) are described. Observations suggest that some individuals have preferred refuges to which they return. (*The Victorian Naturalist* **128**(4), 2011, 132-136)

Keywords: *Parasuta flagellum*, basalt, grasslands, stone, refuge

Introduction

The Little Whip Snake *Parasuta flagellum* is a small, lizard-eating, nocturnal elapid snake commonly encountered during the day beneath surface stones on the basalt plains grasslands to the north and west of Melbourne (James 1979; Fyfe and Booth 1984; Turner 1989). During the coolest months of the year, from approximately May to September, *P. flagellum* are generally inactive and remain beneath the same stone (Turner 1989, unpubl. data). During the species' active season (October to March) when either sloughing is imminent or conditions are unusually cool, they tend also to remain beneath the same stone but for shorter periods (pers. obs.). In addition, gravid female *P. flagellum* have been recorded occupying the same refuge for several months at a time during summer (Turner 2001). In this paper, examples are described of *P. flagellum* being located more than once beneath the same day-time refuge over periods of time that include the species' active season. The examples indicate that some individuals have a tendency to return to refuges that they have previously occupied.

Methods

Observations occurred between 1991 and 1995 during field surveys in grasslands at three sites situated to the north and west of Melbourne: Bundoora (37°42'S, 145°03'E), Craigieburn (37°38'S, 144°58'E) and Deer Park (West) (37°46'S, 144°46'E). Since the objective of the surveys was to collect census data on *P. flagellum* over many sites, rather than the mark-recapture of individuals, the observations described below resulted from limited repeated sampling at these sites. Snakes were located beneath stones in grasslands during daylight hours. The maximum linear dimensions of the stones (length × width × thickness) were measured with a flexible tape measure (± 10 mm), and the substrate type was noted. Snout-to-vent length (SVL) and tail length (TL) were measured using a 500 mm rigid laminate ruler (± 1 mm). For some, but not all individuals, head length (HL: the distance along the midline from the tip of the rostral scale to the furthest point of contact of the two parietal scales) was measured with a vernier calliper (± 0.02 mm) and mass (M) was determined using an Ohaus Cent-o-Gram balance (± 0.1 g). As repeated measurements of the same individual were taken at different times, sets of measurements were deemed to be the same if they were within ± 5 mm for SVL and TL and ± 0.2 mm for HL. In addition, the following characteristics were recorded for each snake: sex (by visual inspection of the tail; see Turner 1992), ventral colouration, the type and location of ventral scute anomalies and injuries. A sketch was made of the top of the head showing the arrangement of the large head scales and the distribution of black pigment on the head and snout. Previous work (Turner 1989, 1998, 2001) with this species indicated that these characteristics were sufficient to identify individual snakes. Snakes were deemed to be 'adult' if SVL exceeded 205 mm for males and 232 mm for females, based

Table 1. Details of the nine examples of repeated refuge use in the Little Whip Snake *Parasuta flagellum* detailed in the text. Refuge size refers to the maximum linear dimensions in metres. Abbreviations for substrate types: L = Loam; C = Clay; S = Stone; G = Grass (dry).

Example	Size Class/ Sex	Initial – Recapture Dates	Refuge Size: length × width × thickness; substrate type	Approx. Time interval (months)	Same refuge?; Distance to same refuge	Growth?
1	Sub-adult male	29/5/93	0.51 × 0.28 × 0.16; L			
		– 7/5/94	0.22 × 0.18 × 0.09; C	11	N; 2 m	Y
2	Adult male	18/7/92 – 26/6/93	0.39 × 0.24 × 0.11; C	11	Y	Y
3	Adult female	4/6/94 – 3/6/95	0.31 × 0.29 × 0.06; C	12	Y	N
4	Adult male	17/8/91 – 18/7/92	0.43 × 0.48 × 0.20; C	11	Y	N
5	Adult female	20/9/92 – 13/5/95	Iron sheet 0.5 × 0.3; G	32	Y	N
6	Adult female	15/8/92 – 6/3/93	0.75 × 0.68 × 0.07; S	7	Y	N
	Adult male	15/8/92 – 6/3/93	0.75 × 0.68 × 0.07; S	7	Y	–
7	Adult male	24/5/92 – 3/3/93	0.60 × 0.35 × 0.08; S	9	Y	N
		– 7/8/93	0.36 × 0.17 × 0.14; S	5	N; 3 m	N
		– 29/5/94	0.60 × 0.35 × 0.08; S	9	Y	N
	Adult female	24/5/92 – 7/8/93	As above	14	Y	N
8	Adult male	29/2/92 – 18/7/92	0.60 × 0.53 × 0.18; C	5	Y	N
9	Adult male	17/8/91 – 13/6/92	0.41 × 0.40 × 0.08; C	10	Y	–

on data provided in Shine (1988), 'juvenile' if SVL was less than 180 mm, and 'sub-adult' if SVL was between these size limits.

Observations

The nine examples described below involved snakes being found beneath a stone they had previously occupied, or another stone very close to it (< 3 m), after periods of five months or more that included at least part of the species' active season. These examples are summarised in Table 1.

1. Darebin Creek, Bundoora. On 29/5/1993 an adult female (SVL 265 mm, TL 37 mm, HL 10.0 mm, M 16.5 g) and sub-adult male (SVL 198 mm, TL 40 mm, HL 8.9 mm, M 8.7 g) were found several centimetres apart beneath a stone resting on loam soil on sloping ground. The refuge and surrounds were inspected seven times during spring and summer but neither snake was located. The male was found again almost a year later beneath a stone at the base of a grass tussock less than 2 m from the original stone. It measured: SVL 240 mm, TL 50 mm, HL 9.7 mm, M 13.5 g, corresponding to an 18, 20, 8 and 36% relative increase in each respective measurement.
2. North of Robinsons Road, Deer Park. On 18/7/1992 an adult male (SVL 370 mm, TL 60 mm) was located beneath a stone resting on damp clay. This stone formed part of pile that had evidently been gathered from surrounding paddocks. The snake was not located on two visits during the active season but was located the next winter beneath the same stone. It measured: SVL 380 mm, TL 60 mm, representing a 3% relative increase in SVL.
3. North of Robinsons Road, Deer Park. On 4/6/1994 two adult females (#1 SVL 294 mm, TL 37 mm, HL 11.1 mm; #2 SVL 290 mm, TL 40 mm, HL 11.6 mm) were located beneath a partially imbedded stone on the side of a small gully. A further two visits failed to locate either snake beneath this or nearby stones. About a year after the original observation, three adult *P. flagellum* (one male and two females) were found in direct body contact beneath the original stone. One of the females was #1 and measurements indicated that no growth had occurred.
4. Clarkes Road, Deer Park. On 17/8/1991 an adult male (SVL 295 mm, TL 63 mm) was located overwintering beneath a stone on a dry clay substrate. This stone was on the edge of stone pile in the middle of a paddock beneath a small stand of Sugar Gum *Eucalyptus cladocalyx*. A visit during the summer months failed to locate the specimen. It was located again nearly a year after the original observation beneath the same stone with an adult female (SVL 259 mm and TL 31 mm). No growth was evident.
5. Darebin Creek, Bundoora Park. On 20/9/1992 an adult female (SVL 274 mm, TL 36 mm)

was found beneath a concave sheet of corrugated iron resting on a dry grassy mat beneath a stand of Black Wattle *Acacia melanoxylon*. A further four visits made over the next two years failed to locate the specimen. Two years and eight months after the original observation the specimen was located beneath the same sheet of iron. No growth was evident and the distal third of the tail was missing; this injury was not recent.

6. South of O'Herns Road, Craigieburn. On 15/8/1992 an aggregation consisting of two adult females (#1 SVL 370 mm, TL 45 mm; #2 SVL 310 mm, TL 28 mm) and a male (that escaped) all in direct body contact was found beneath a broken slab of exfoliating basalt. The aggregation was observed again on the 24/10/92 but was not disturbed. Seven months after initially being located, the male and female #1 were still present beneath the exfoliation. The female appeared to be post-parturient; this was indicated by the presence of a lateral skin fold along the posterior third of the body and palpated 'hollow' abdomen. No growth was evident in the female.
7. North of O'Herns Road, Craigieburn. On 24/5/1992 an adult male (SVL 340 mm, TL 57 mm, HL 11.0 mm) and small adult female (#1 SVL 235 mm, TL 27 mm, HL 6.2 mm) were located 0.2 m apart beneath a fractured slab of exfoliating basalt consisting of three loose and a fourth immovable piece. On the next visit (3/3/1993) only the male was located. On 7/8/1993 female #1 was present, along with a second adult female (#2 SVL 320 mm, TL 38 mm, HL 10.9 mm); 3 m away, beneath a smaller stone, was the male. No growth was evident in either snake. On 20/11/1993 female #2 (no measurements taken) was located beneath the slab, while the male and female #1 could not be located. On 12/2/1994 only one snake, a gravid female (#3 SVL 263 mm, TL 32 mm, HL 6.9 mm) was located beneath the slab; a relatively fresh adult slough was located within centimetres of where she lay. On the final visit (29/5/1994), three snakes were beneath the slab: the male, female #3 and another female which escaped beneath the immovable piece of the slab (very likely female #2 based on snout pigment). No growth was evident in either the male or female #3.
8. North of Robinsons Road, Deer Park. On 29/2/1992 an adult male (SVL 318 mm, TL 62 mm) was located in pre-slough condition beneath a stone on cracked clay soil. It was located a week later, having sloughed (though there was no sign of the skin), and located again in mid-winter beneath the same stone. No growth was evident.
9. North of Robinsons Road, Deer Park. On 17/8/1991 an adult male (SVL 330 mm, TL 60 mm) and female (SVL 315 mm, TL 40 mm) were located intertwined beneath a stone situated in a swathe of Kangaroo Grass *Themeda triandra*. A further three visits to the site failed to locate either snake. The following year at the start of winter only the male was located beneath the same stone (and remained there over winter). No follow-up measurements were made.

In addition to these observations, at least another 11 snakes (other than gravid females) were found beneath a previously occupied stone during the active season after time intervals between three and 13 weeks. These additional observations comprised nine adults (six females, three males), one sub-adult (male) and one juvenile (female). Four of these observations involved snakes being located beneath the same stone on three separate occasions, while the remainder was located twice.

Discussion

The observations suggest that some *P. flagellum* return to day-time refuges they have previously occupied and therefore do not move about their habitat in a completely random way. The probability of locating the same individual snake beneath the same stone following periods of five or more months would appear to be very small, as there are apparently suitable refuges not only in the immediate vicinity, but also in the wider area where observations occurred, as indicated by the presence of many other *P. flagellum* beneath stones. Individual snakes were not completely sedentary between observations as in some instances they were not located beneath the original refuge in (one or more) follow-up visits to sites (Examples 1-5, 7, 9). Furthermore,

sites were checked only by day, whereas *P. flagellum* are known to be predominantly nocturnal (Fyfe and Booth 1984; Wilson and Knowles 1988; Coventry and Robertson 1991; Ehmann 1992) though limited diurnal activity does occur; (Turner 1998, 2001) and therefore nighttime activity away from refuges cannot be excluded. Five of the examples (1-4, 9) recorded snakes beneath the same refuge in successive winters, possibly indicating fidelity to particular overwintering refuges. Additional observations indicate that particular stones were 'favoured' by *P. flagellum*, and that on almost every visit they were occupied, though not necessarily by the same individual (pers. obs.). Basalt exfoliations were almost always occupied by *P. flagellum*, but were not common at any of the sites compared to stones that lay directly on soil.

It is possible that disturbance by the observer may have influenced the movements of *P. flagellum*, and caused them to move from a refuge and remain away from it. It was generally observed that during the species' inactive season snakes tended to remain beneath the same refuge while those located during the active season tended to vacate refuges. This trend may be explained simply by conditions being less suited to movement during the colder months compared to the warmer months; however, movement during the warmer months might also be due to disturbance. While more frequent sampling may have resulted in clearer patterns of movement, it also may have influenced these patterns unduly.

As all snakes except one in the examples above were adults, and the time interval between the initial and the final observations were typically around one year or less, it is not surprising that little or no growth was recorded. The most substantial growth recorded was in a sub-adult male (Example 1).

Given the relatively small size of many basalt plains grassland reserves and remnants (DCE 1990; McDougall and Kirkpatrick 1994) and the close association that *P. flagellum* (and other reptile species) have with basalt outcrops within these areas, it is important that the extent of movement and home-range size of species such as *P. flagellum* be determined in order to better inform land managers about the conservation needs of these species. Home-range size is known in only a small number of Australian elapid snakes and in these species there is a pattern for males to have considerably larger home ranges than females (Webb and Shine 1997, Fitzgerald *et al.* 2002, Whitaker and Shine 2003). For example, male Eastern Brown Snakes *Pseudonaja textilis textilis*, which are common inhabitants of some northern basalt plains grasslands, have been determined to have a mean home-range size of 11.8 ha while for females it was 1.5 ha (Whitaker and Shine 2003). Whether these home-range sizes determined from *P. t. textilis* populations inhabiting rural NSW are applicable to other populations in different habitats is not known. A species that is similar to *P. flagellum* in terms of size, activity period and diet is the Eastern Small-eyed Snake *Rhinoplocephalus nigrescens* and its movements have been extensively studied (Webb *et al.* 2003, Keogh *et al.* 2006). Male *R. nigrescens* moved over larger distances than females, with the mean straight-line distance between capture and recapture being 99 m for males (0 – 346 m) versus 35 m for females (0 – 140 m); 55% of females were recaptured within 20 m of their original location, six were located beneath the same stones and some used the same stone each year during the reproductive season. A study of *P. flagellum* that focuses on the movements of individual snakes would not only enable home-range size to be determined, but could also clarify the extent of repeated refuge use documented in this work.

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One Hundred and twenty-seven Years Ago

Notes on Victorian venomous snakes
by
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(Read 21st April, 1884)

Venomous snakes destroy their prey by poison. Some, such as the Copper-headed, when they have caught and bitten an animal, commence swallowing it at once, while yet alive, but the Tiger Snake does not touch its prey after it has bitten it until life is quite extinct. When swallowing, the jaws are moved alternately. This is possible from the freedom of movement which is obtained by all the bones of the head being united by elastic ligaments, so that the head and jaws can stretch considerably. Hence also snakes can swallow prey apparently larger than themselves. Occasionally two snakes will seize upon the same prey, and as neither will give way, the larger swallows the lesser, until the latter is compelled to relax its hold on the prey and withdraw from the contest. I lately heard of a case where a large snake had swallowed a smaller one in the manner described, but the latter had gone too far down to be able to recede, and died, and when the larger snake was opened, it was found to have partially digested its opponent, only the tail remaining uninjured. The Tiger Snakes and Death-adders generally prefer mice and rats. Rats do not succumb readily to the poison, and take a long time to die. Lately I saw a small native cat bitten severely by three large Tiger Snakes, with about five minutes' interval between each bite, and it took an hour and a half to die. The other snakes prefer frogs as an article of diet ...

Snakes shed their teeth, new ones being rapidly produced. There are always a number of immature fangs behind the two in use, and if these are destroyed by any accident, another pair will be fully developed and ready for use in about six days. The point of the fang is extremely fine and solid, the tooth being perforated in its lower three-fourths. The channel is enamelled. The fangs of all our snakes are permanently erect, and when the mouth is closed, fit into a depression in the lower jaw. The jaws do not close on each other, but also fit into depressions.

If frightened during a meal, snakes sometimes disgorge. I once saw a Tiger Snake kill and swallow five mice in succession. Finding that they were more than could be managed, it retained only three. The digestion is good, and probably assisted by the venom injected, as it has been shown recently that it possesses peptic qualities.

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